Traumatic brain injury (TBI) is an expanding public health epidemic, and 75% of cases are mild.1 TBI is poorly recognized by patients and primary care clinicians. It has high impact in epidemiological and economic terms as well as loss in quality of life, particularly in physical dimensions.2,3 Over 7 million brain injuries occur yearly in the United States, with a death rate of 22-25/100,000.4 Approximately 52,000 adults die, 275,000 are hospitalized, and 1.365 million—nearly 80% of diagnosed cases—are treated and released from an emergency department; the number who are not seen or treated is unknown.4

Approximately 10%-20% of patients with mild TBI continue with psychosocial problems, mostly mood disorders. Those with mild TBI have higher rates of depression and poor global outcome than those with more severe disease.1 Depression is a risk factor for poor recovery.1-4 Risk of TBI is highest for men age 14–24. Among the military branches, TBI affects 231/100,000 men and 150/100,000 women age 18–24.4 TBI is a contributing factor to a third (30.5%) of all US injury-related deaths.2 About 75% of TBIs that occur each year are concussions or other mild forms.5

TBI occurs when an external force impacts the brain, alters consciousness, impairs cognitive abilities or physical functioning, and requires costly treatment. More than 5.3 million Americans live with cognitive, physical, and behavioral disabilities related to TBI resulting from sports impact, bombs, blasts, childhood injury, or falls. Direct hospital and medical costs equaled $4.5 billion and indirect costs were $37.5 billion.5 People with TBI and their families report that this condition is poorly recognized by primary care health professionals. The risk of TBI can be reduced by preventive measures (eg, seat belts, air bags, car design, safety helmets, and drunk driving prohibitions).4,6-8

Mild TBI is often misdiagnosed because symptoms may be missed, sedatives may temporarily mask mild or moderate TBI, and evidence-based correlates of these clinical manifestations are lacking. Damage may range from mild with a temporary concussion, headache, and dizziness to moderate, severe, or potentially fatal. In 1 study, 35% of 1853 people reported experiencing at least 1 TBI and said they were not treated but experienced symptoms 3 months after the injury.7 The impact can alter consciousness (eg, amnesia, confusion, or loss of

ABSTRACT

Nurse practitioners have a major role to play in the detection and diagnosis of traumatic brain injury (TBI), which can be challenging if symptoms appear after the injury but go unrecognized. TBI should be considered when the patient reports a possible brain injury or experiences driving, sports, assault, falls, injuries, and combat. Recognizing the broad spectrum of symptoms will help NPs remain alert to the possibility of a TBI. Because symptoms are diverse and patients may not realize that the brain was injured, clinicians need a high index of suspicion. Early identification can improve treatment effectiveness, rehabilitation, and prognosis.

Keywords: brain injury, neurological

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consciousness), fracture the skull, or damage the brain. Fifteen percent of people with mild TBI have symptoms that last a year or more. Education helps patients and family understand and cope with the consequences and symptoms. The Veterans Administration and Department of Defense have guidelines for managing mild TBI.

This article focuses on the mild TBI that may often be present in primary care clinics and recognition of its symptoms. To update your knowledge about this disorder, this article focuses on the pathophysiology, symptoms, and assessment. Several nurse practitioner (NP) specialties may come in contact with TBI, including clinicians with FNP, ANP, ACNP, PMHP, and WHNP (during wellness exams for women) designations. TBI is diverse in presenting symptoms; therefore, the range of sensory, motor, and other losses are described. Along with multidisciplinary colleagues, the NP plays an important role in case finding, assessment, management, and education.

CASE ILLUSTRATION

History: RM is a 52-year-old professional woman presenting to the primary care clinic with her sister and a friend. She reports recent insomnia, headache, and poor concentration. She sleeps 4-5 hours a night and reports difficulty concentrating. Recently while driving, she hit another car. She was not injured, but she left the scene of the accident without checking the other driver, saying it was just a small fender bump. Her sister and friend report that RM has been uncharacteristically angry, forgetful, and very short-tempered recently, and leaving the scene of the accident was atypical and resulted in pending legal issues. Her sister says RM is usually an outgoing, organized person who is cheerful and responsible.

Based on the history and negative mental status and physical findings, the NP treated the headache and ruled out a possible stroke, transient ischemic attack, mood disorder, and possible dementia but did not think about a TBI because RM denied any injuries, bumps, or bruises from the accident. RM’s risk of TBI was not evaluated or considered in a differential diagnosis.

PATHOPHYSIOLOGY

TBI pathophysiology is not completely clear. TBI may result from a closed head injury or a penetrating wound. Open injuries occur when a fracture, bullet, or sharp object penetrates the scalp, skull, meninges, and brain tissue. Closed head injury (eg, pressure from a bomb blast or a football pile-up) occurs with acceleration and deceleration of the brain that may potentially involve a skull fracture. The head injury may cause microscopic or gross structural changes ranging from minor to major. Intracranial damage can be focal, such as epidural and subdural hematomas, parenchymal contusions, or diffuse edema. Minor trauma may have no structural changes. Secondary damage results from complications (eg, infection, hemorrhage, hydrocephalus, edema, respiratory failure, and hypotension).

The outcome of a head injury depends on the brain’s preinjury status, the total immediate damage from the impact, and the cumulative effects of secondary pathological damage to the injured brain. Signs and symptoms of TBI vary, depending on the location and severity of the insult. Blood vessels and axons can be sheared or torn, causing leaks and creating bruising, hemorrhage, or hematomas. Often, however, one third of patients see no evidence of injury or bleeding and conclude that the symptoms were not bothersome and that the injury was not serious.

EPIDEMIOLOGY

Because of inconsistent definitions, classifications, and measurements, the epidemiology of TBI is difficult to describe accurately. An annual estimate for TBI among children 14 and younger is 511,257, while TBI in adults 65 and older is 237,844. While these are high risk groups, NPs who treat other age groups can expect TBI in them as well. The incident rate for ages 15-25 is 31.7%, ages 26-35 is 22.5%, ages 36-45 is 19.5%. TBI-related emergency department visits accounted for a larger proportion in children (92.7%) compared to the same visits among older adults (59.7%). An estimated average annual number of 998,176 TBIs among males is higher than the 693,329 among females. Children and elders are at highest risk for falls.
Motor vehicle accidents (MVAs) are the second largest cause of TBI for all age groups. Percentage of diagnosed TBI from an MVA who were men (59%) exceeded the percentage of women. Children younger than 4 accounted for about 18% of all TBI-related emergency visits, and adults over 74 accounted for 22% of TBI-related hospitalizations. Overall, approximately 1.4 times as many TBIs occurred among males as among females. Falls and MVAs (eg, car and motorcycle) most commonly cause severe TBI. Other causes include assaults and industrial accidents. When violence causes TBI, the individual has more symptoms, poorer reintegration, and greater disability.

SIGNS AND SYMPTOMS
TBI has no set pattern of symptoms because deficits reflect the area of the brain injured and the degree of injury. The severity of symptoms is defined by the Glasgow Coma Scale (GCS) score, loss of consciousness, and posttraumatic anesthésia. Disorders of sensation, behavior, emotions, learning, memory, information processing, planning, organizing, and communication are common. TBI produces a host of behavioral changes, and specialized training in behavioral management is essential to resolve crises and calm aggressions. Symptoms typically occur in the following major categories, so the advanced practice nurse needs to recognize these problems and patterns of symptoms. Often, the individuals who see no evidence of bleeding or injury conclude that all is well. They fail to realize that the brain may have suffered in the injury and sustained a TBI with some of the following problems.

Psychosocial Problems
While up to 20% of patients with mild TBI may have depression or mood disorders, other problems may include anger, poor concentration, swearing, yelling, physical violence, and sexually offensive behavior from decreased inhibitions. TBI increases the risk for depression, bipolar disorder, suicide, acute stress disorder, posttraumatic stress disorder, antisocial or aggressive behavior, and substance abuse. Anxiety disorders and depression are common and often continue for a year after the trauma.

ASSESSMENT
The clinician collects data to evaluate the degree of impairment in physical, cognitive, behavioral, and psychosocial problems. Sensory deficits are common after brain damage. Disruptions may include impaired smell, vision, hearing, equilibrium, taste, and sematosensory perception that emerge from trauma to the sensory organs. People may have limb numbness and visual deficits in which bright lights and noise are often painful. Hearing loss and tinnitus is common after a bomb blast. Those with visual field loss can learn to compensate by increased scanning. For example, a man with TBI lost his peripheral vision and would easily walk into a post on the impaired side. He learned to scan the environment for dangerous objects and avoid them. Visual sensory deficits may include blind spots or blurred vision and difficulty recognizing objects. Visual problems, such as myopia, can be reduced through treatment or lenses. If they become deaf, people can learn sign language or can work with a speech and language therapist to learn alternative communication strategies. If the brain trauma has paralyzed a limb, sensory loss may occur.
functioning. An important initial history question is whether the patient has suffered any trauma, such as blow to the head from a fall, accident, or explosion that may have preceded the onset of symptoms (Table 1). Although amnesia may occur after injury, people are likely to report the associated somatic (eg, headache, dizziness, balance impairment) and neuropsychiatric symptoms (eg, irritability, memory loss) after the injury. Routine assessment of the patient’s clinical condition is an essential in the management of a TBI outpatient. This assessment should include:

- Acute medical or psychiatric symptoms, such as the emergence of migraine headaches, emotional outbursts or worsening depression
- Pain level and intensity and the quality/quantity of sleep
- Medication compliance and assessment of any adverse reactions
- Mental status and neurological evaluation
- Physical therapy and occupational therapy exam

Information to collect about history and physical exam is outlined in Table 2.

Table 1. Common and Associated Symptoms of Mild and Moderate TBI

<table>
<thead>
<tr>
<th>Level of TBI</th>
<th>Common Symptoms</th>
<th>Associated Symptoms</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Mild:</strong> The person looks normal and symptoms are easy to miss.</td>
<td>Fatigue, Headaches, Visual disturbances, Memory loss, Poor attention/concentration, Sleep disturbances, Dizziness/loss of balance, Irritability/emotional disturbances, Feelings of depression, Seizures</td>
<td>Nausea, Loss of smell, Sensitivity to light and sound, Mood changes, Getting lost or confused, Slowness in thinking</td>
</tr>
<tr>
<td><strong>Moderate:</strong> The list of mild symptoms grows to include the following possibilities to the right.</td>
<td>Persistent headache, Repeated vomiting or nausea, Convulsions or seizures, Inability to awaken from sleep, Dilation of 1 or both pupils, Slurred speech, Weakness or numbness in the extremities, Loss of coordination, Profound confusion, Agitation, combative ness</td>
<td></td>
</tr>
</tbody>
</table>

TBI = traumatic brain injury.

Testing may include neuropsychiatric testing or brain imaging and is typically a multidisciplinary activity because no one discipline can typically answer all of the issues that emerge during rehabilitation. Tests may include a GCS, computerized tomography [CT] scans, and monitoring of intracranial pressure, as well as neuropsychological tests. Crisis intervention skills are useful in evaluating TBI.17

DIFFERENTIAL DIAGNOSIS

Diagnosis reflects a detailed neurological exam to evaluate brain injury and brain imaging with various tests (eg, computerized axial tomography, MRI, single-photon emission CT, and positron emission tomography). Neuropsychological testing may clarify cognitive functioning. Physical, occupational, and speech therapists evaluate the specific sensory motor and behavioral deficits and strengths.8

TREATMENT

Recovery of mild TBI happens quickly over the 18–36 months after injury, with 80%–85% of recovery occurring in the first 6 months. During the acute treatment, diuretics reduce swelling or fluid overload, and antiepileptics help reduce seizures. Most people with mild TBI recover rapidly and return to functioning in about 3 months.18 People with a prior head injury are at risk for symptoms that last longer than a few weeks. About 20% of individuals who have mild TBI will continue to experience problems and require ongoing medical care. When this occurs, the disorder is called postconcussion syndrome.
The NP's treatment of mild TBI includes education, rest, observation, and treatment of persistent or bother-some symptoms. Treatment for continued headache and sleep disruption includes nonsteroidal anti-inflammatory drugs (NSAIDs), tryptans, and Midrin. If the headache accompanies dysregulation, valproate is useful. Selective serotonin reuptake inhibitors may be useful for depression and irritability after brain injury. Patients often complain of fatigue, irritability, and labile mood. They are discouraged and require education to understand the time required for the brain to recover. They tend to associate emotional symptoms with the idea that they are going crazy and do not realize that these symptoms are typically related to the brain injury. NPs can teach approaches to stop unwanted thoughts by using cognitive behavioral interventions and reducing negative thoughts. Stress reduction and relaxation strategies help reduce insomnia and hyperalertness.

DEPRESSION

Major depression is a costly but treatable mood disorder characterized by sad mood or loss of interest or pleasure, with a total of 5 symptoms over 2 weeks (eg, fatigue, significant weight loss, insomnia, diminished concentration,}

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**Table 2. History and Physical Exam**

<table>
<thead>
<tr>
<th>Topic</th>
<th>Data to Collect</th>
<th>Exam</th>
</tr>
</thead>
<tbody>
<tr>
<td>Headaches</td>
<td>Precipitants, quality, frequency, severity, location, duration, type</td>
<td>Abnormal gait/cerebellar</td>
</tr>
<tr>
<td>Balance problems</td>
<td></td>
<td></td>
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<tr>
<td>Fatigue</td>
<td></td>
<td></td>
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<tr>
<td>Sleep disturbance</td>
<td></td>
<td></td>
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<tr>
<td>Dizziness/vertigo</td>
<td></td>
<td></td>
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<tr>
<td>Ambulation</td>
<td></td>
<td></td>
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<tr>
<td>Pain</td>
<td></td>
<td></td>
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<tr>
<td>Malaise</td>
<td></td>
<td></td>
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<tr>
<td>Bowel problems</td>
<td></td>
<td></td>
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<tr>
<td>Bladder problems</td>
<td></td>
<td></td>
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<tr>
<td>Sensory</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Hearing/tainnitus</td>
<td></td>
<td></td>
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<tr>
<td>Vision problems; hypersensitivity to noise, light</td>
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<td></td>
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<tr>
<td>Taste/smell</td>
<td></td>
<td></td>
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<tr>
<td>Seizures</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Motor/mobility problems; numbness</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Weakness/paralysis</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Speech/swallowing</td>
<td>Location</td>
<td>How often is able to be understood</td>
</tr>
<tr>
<td></td>
<td>Frequency, precipitants, quality, duration</td>
<td></td>
</tr>
<tr>
<td>Sexual dysfunction</td>
<td>Onset, duration, problem of desire, performance, satisfaction</td>
<td></td>
</tr>
<tr>
<td>Behavioral disturbance</td>
<td>Type, frequency, precipitants, quality, duration, triggers</td>
<td>Conduct screening (PTSD, etc). Mini Mental Exam: if problems in memory, learning, concentration, or attention, request neurocognitive testing or neuropsychiatric evaluation</td>
</tr>
<tr>
<td>Psychiatric problems</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Cognitive disturbance</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Memory loss</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Dental/oral</td>
<td>Problems, missing or cracked teeth, TMJ; misaligned jaw</td>
<td>Refer for dental exam</td>
</tr>
<tr>
<td>Endocrine dysfunction related to TBI</td>
<td>Precipitants, quality, frequency, severity, location, duration, type</td>
<td>Refer</td>
</tr>
<tr>
<td>Autonomic nervous system</td>
<td></td>
<td>Orthostatic hypotention, hyperhidrosis—consider or refer for autonomic nervous system evaluation</td>
</tr>
</tbody>
</table>

PTSD = Post-Traumatic Stress Disorder; TMJ = Temporomandibular Joint Disorder; TBI = traumatic brain injury.
thoughts of death or suicide). It is not a short-term emo-
tional upset or a few days of sadness. A diagnosis of major
depression requires all the criteria listed above; milder ver-
sions include dysthymia with fewer symptoms for a longer
period. The Diagnostic and Statistical Manual (DSM) diag-
nostic criteria for depressive disorders identify some of the
mood symptoms. A depressive episode may also be the
result of another medical condition, such as TBI.
Depression intensifies suffering, morbidity, and suicidal
thoughts, but the diagnosis is often missed or undertreated.

Depression includes weeks and months of costly and
needless emotional suffering. It increases costs of treating
other disorders, triggers short-term disability, and impairs
work performance. Untreated depressive disorders
increase costly clinic visits, hospitalizations, substance
abuse, risky behaviors, and reduce adherence to treatment
and quality of life. Treatments for major depression are
effective and beneficial.

REHABILITATION
Rehabilitation of TBI requires an early and well-coordinated
multidisciplinary approach. Evidence-based interventions
were suggested for four areas: neuropsychological rehabilita-
tion of attentional disorders, neuropsychological rehabilita-
tion of neglect disorders, neuropsychological rehabilitation of
dysexecutive disorders, and rehabilitation trainings for
patients with mild TBI. Treatment focuses on coma man-
agement and control of behaviors that could lead to harmful
outcomes (eg, agitation, angry outbursts, and impulsivity).

Cognitive restructuring has long been the corner-
stone of specialized TBI inpatient rehabilitation pro-
grams. Both individual and group therapy, structured
milieu, and recreational and occupational therapy are useful,
although ongoing and costly. Outpatient interven-
tions assist the development of personal awareness,
cognitive function, social skills, and vocational readiness.
Wii videogames are gaining popularity as useful adjuncts
in physical rehabilitation. In outpatient settings, the clinici-
ian plays a considerable role conducting a clinical assess-
ment and providing rehabilitative and emotional support.
Rehabilitation may include measures of quality of life
and functional disability. Rehabilitation also includes
education, coaching, and emotional support.

EDUCATION AND COACHING
In rehabilitation, the nurse functions as both educator
and coach for the patient and family. In addition to a dis-
cussion of TBI and expected course of recovery, the
nurse will also guide the development of a consistent
daily schedule with healthy meals and cognitive and
physical exercises. Patients may need help with establish-
ing a weekly schedule (eg, menus, shopping lists, and
appointments). Memory aids, such as sticky notes, an
expanded calendar, and alarms, may be useful. Education
in relaxation techniques, such as progressive relaxation,
deep breathing, or meditation, may reduce stress and
increase calm. The nurse may identify distractions,
courage coping strategies, and teach the concept of
focusing on 1 component of a task at a time.

Patients may need assistance to develop realistic short-
and long-term goals and begin participation in new activi-
ties, particularly those involving socialization. When the
patient becomes agitated easily, he or she needs help to
identify triggers that lead to emotional outbursts or social
withdrawal and identify positive coping strategies.

People with prior histories of poor coping or emotional
regulation may experience more symptoms than those with
robust coping or self-management skills. Alternatively, the
individual may be resilient and have developed strengths in
focusing, confronting issues, and adapting to challenges.
Emotional support is critical to the recovery of the TBI
patient and their family. Typically, a third of patients with
TBI report mild aggression, and another third report mod-
erate aggression. These patients need strategies to man-
age affect and aggression and to help the family understand
affect regulation. The family plays an essential role in the
patient’s rehabilitation and therefore should be involved in
all aspects of the therapeutic process.

The nurse in this phase of treatment should:
• Support and praise for all successes (eg, maintaining
  schedule, using positive coping strategies, attempting
  new experiences)
• Support expressions of grief
• Provide information about community support
groups
• Assist the family in identifying its strengths and pos-
teive coping strategies
• Reinforce positive coping techniques
• Encourage family discussions on how best to sup-
port the patient and how to cope with aggression
and emotional reactions
• Explore with patient and family the ways in which
TBI has changed their lives
• Encourage verbalization of thoughts and feelings
COGNITIVE BEHAVIORAL THERAPY

As a coach, the psychiatric NP may use cognitive behavioral therapy, including individual, group, and family therapy, which is particularly useful for treating depression. One study evaluated the impact of cognitive behavioral therapy (CBT) on acquired brain injury and found that CBT treatment significantly improved symptoms, depression, and anxiety. Compared with controls, treatment was effective both in groups and telephone counseling. Cognitive therapy—an effective, directive, time-limited approach to helping change irrational thoughts, assumptions, and beliefs—and antidepressants have been effective.

CBT teaches about automatic negative thoughts and attitudes about oneself, the world, and the future in determining mood. NPs can teach patients to identify and change their negative thinking patterns and automatic thoughts. Treatment includes amending negative and automatic thoughts, emphasizing small steps of mastery, and acknowledging pleasant activities. Activities include the person’s potential for mobility, hearing, or visual limits. Recommendations for prevention are also important to prevent reinjury (Table 3).

CONCLUSION

Although 75% of TBI cases are mild, they cause major physical and emotional disruption. TBI has high impact in economic terms, as well as loss in quality of life. About 20% of individuals with mild TBI will continue to experience problems and require ongoing medical care. The diagnosis of TBI is often missed by primary care clinicians who do not realize that emotional symptoms, depression, and physical symptoms may stem from the head injury. The NP has a major role to play in detecting TBI and its associated depression and emotional symptoms. Management may include therapy, medications for depression, and treatment for a host of other symptoms, depending on the brain area impacted. Patients may need help with coping and self-management strategies as well as symptom management, education, coaching, and referrals.

Table 3. Traumatic Brain Injury Prevention

<table>
<thead>
<tr>
<th>Prevention</th>
<th>Methods</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Vehicle safety</strong></td>
<td>Always wear a seatbelt in a motor vehicle&lt;br&gt;Use an appropriate child safety seat or a booster&lt;br&gt;Never drive under the influence of alcohol or drugs&lt;br&gt;Always wear a helmet when on a bicycle, motorcycle, scooter, snowmobile, and other open, unrestrained vehicles&lt;br&gt;Wear a helmet when participating in contact sports&lt;br&gt;Wear a helmet when horseback riding&lt;br&gt;Wear a helmet with skis, snowboards, skates, and skateboards</td>
</tr>
<tr>
<td><strong>Fall prevention</strong></td>
<td>Use the rails on stairways&lt;br&gt;Provide adequate lighting, especially on stairs for people with poor vision or who have difficulty walking&lt;br&gt;Place bars on windows to prevent children from falling&lt;br&gt;Sit on safe stools&lt;br&gt;Do not place obstacles in walking pathways</td>
</tr>
<tr>
<td><strong>Firearm safety</strong></td>
<td>Keep guns locked in a cabinet&lt;br&gt;Store guns unloaded&lt;br&gt;Store ammunition apart from guns</td>
</tr>
</tbody>
</table>

References

The Nurse Practitioner’s Role Continued from page 862

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